Dec. 8, 1959 W. R. FOIT ET AL 2,916,026

AIR INTAKE FOR FREE PISTON ENGINES

Filed June 23, 1958 3 Sheets-Sheet 1

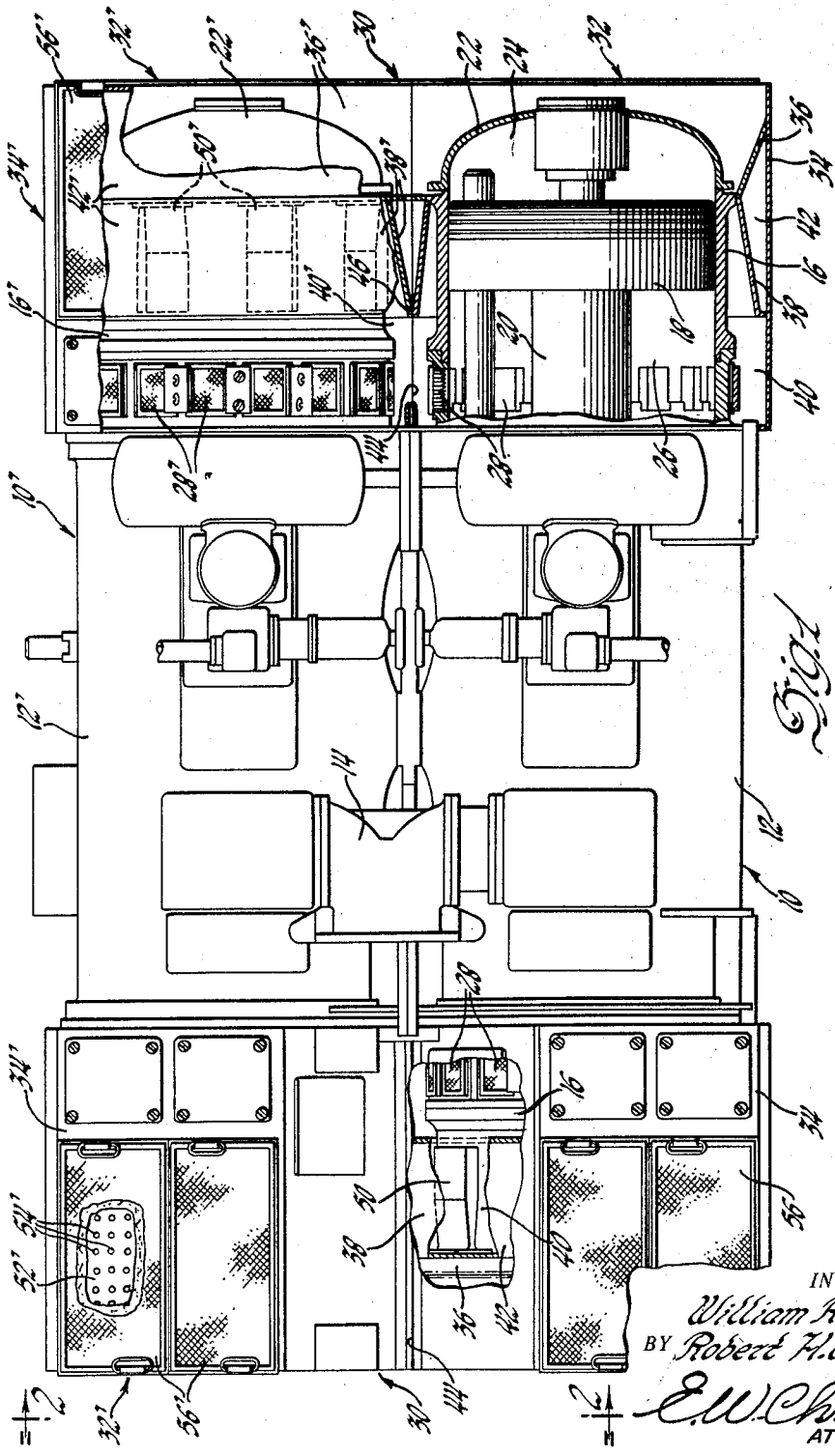


Fig. 1

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Filed June 23, 1958 3 Sheets-Sheet 2

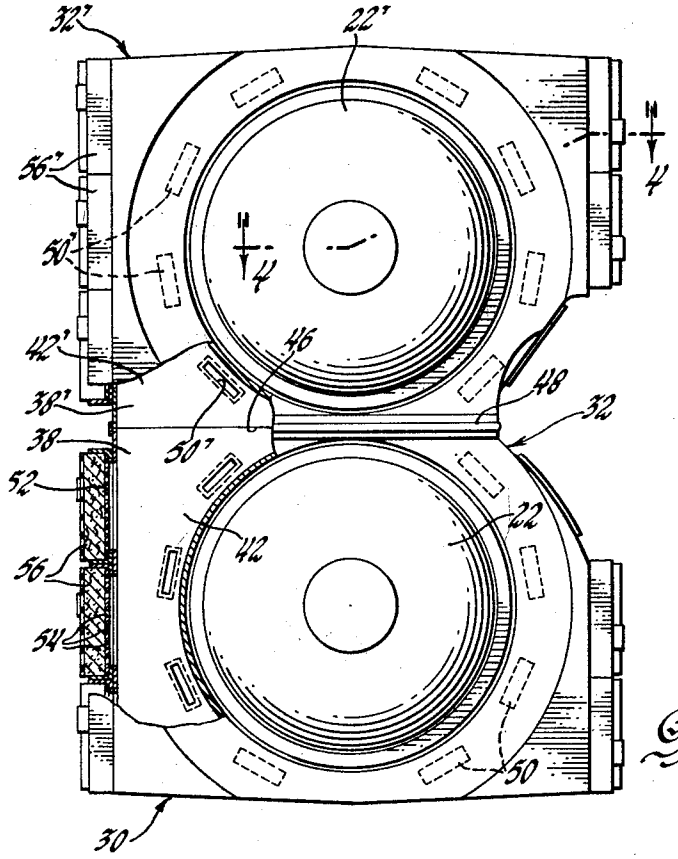


Fig. 2

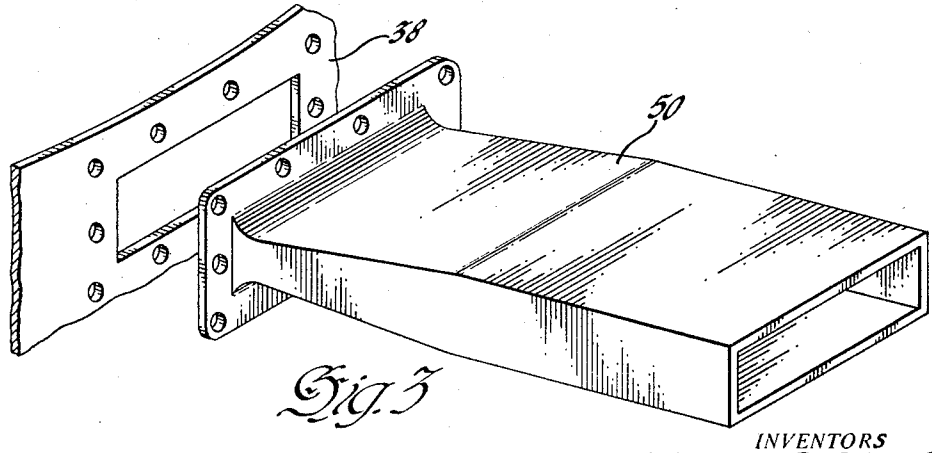


Fig. 3

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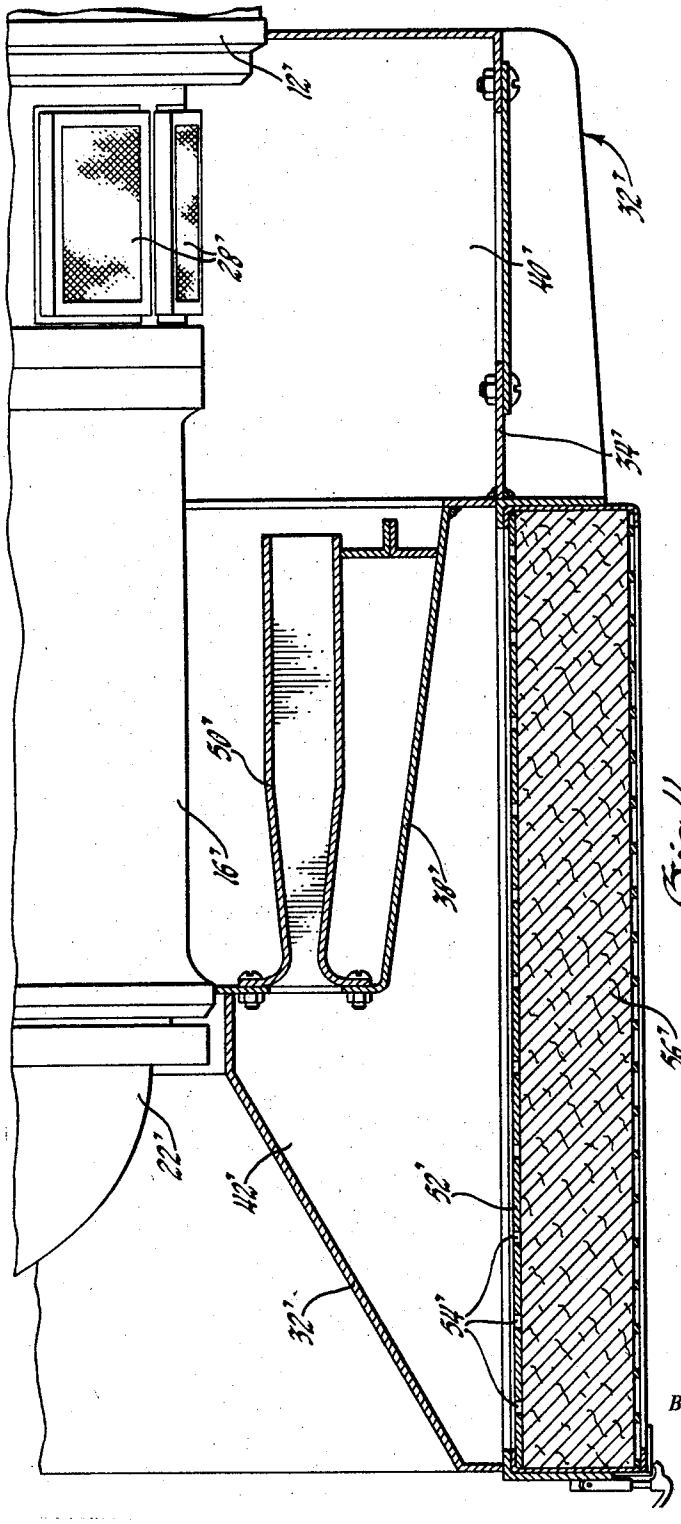


Fig. 4

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AIR INTAKE FOR FREE PISTON ENGINES

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6 Claims. (Cl. 123—46)

This invention relates to free piston engines and more particularly to sound suppressing air intakes therefor.

Free piston engines are characterized by two major annoyances which stem from the periodic massive air inhalations of the compressor cylinders during engine operation. The first annoyance is high frequency sound which is painful to the hearing and which is generated by intake air rushing through the compressor cylinder intake valves. The second annoyance is low frequency sound which is generated if the air inhalations take place in a concentrated area and while this low frequency sound is not necessarily painful to the hearing, it can set up wall vibrations in the room which houses the engine. The room and the personnel therein can be protected against the sound disturbances by surrounding the compressor air intake with duct work extending outside of the room. This form of protection is not feasible in many cases because of cost and space limitations and is also objectionable when habitations are located in the immediate area of the engine room for such habitations are then subjected to the sound disturbances.

An object of the invention is to provide a free piston engine with an air intake housing for the compressor that will reduce such sound disturbances to a tolerable level so that the engine can be supplied with air from the engine room.

The invention provides a housing about the compressor valving forming a first chamber in communication with the valving and a second chamber in communication with the first chamber through venturis and in communication with the room air through a multitude of small apertures. The venturi throat areas are related to the air intake flow of the engine to obtain substantially sonic air flow between the chambers and thus prevent the high frequency valve sound from escaping the first chamber. The second chamber then spreads the air intake over a considerable area of the engine room through the multitude of inlet apertures to prevent low frequency sound build-up. The air intake through the apertures may generate some high frequency sound but this is at such a low energy level as to be readily tolerated.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a front elevation, partially broken away, of a Siamesed free piston engine incorporating the inventive air intake;

Figure 2 is an end elevation of the air intake taken on the plane indicated by the line 2—2 of Figure 1;

Figure 3 is a perspective of one of the air intake venturis; and

Figure 4 is a partial section through the air intake, taken substantially on the plane indicated by the line 4—4 of Figure 2.

The invention is shown as applied to a free piston gasifier that includes a lower engine 10 that is paired or Siamesed with an upper engine 10'. The illustrated gasifier is 14 feet in length and while such a size gasifier can power a locomotive, it can also make a lot of noise. The center portions of the engines 10 and 10' have scavenge air boxes 12 and 12' which communicate with each other and which house diesel cylinders (not shown) that exhaust to a turbine (not shown) by way of a common exhaust pipe 14. Compressor cylinders 16 and 16' are secured to the ends of the diesel cylinder air boxes and each cylinder has a compressor piston 18 reciprocal therein which mounts a diesel piston 20 that is reciprocal in the diesel cylinder, the arrangement providing each engine with opposed free piston assemblies. End covers 22 and 22' close off the outboard ends of the compressor cylinders 16 and 16' to provide each compressor piston with a bounce chamber 24 at its outboard side, a compressor chamber 26 being formed by the air box and compressor cylinder at the inboard side. Annular rows of air intake valves 28 and 28' are mounted in the compressor cylinder walls to supply air to the compressor chambers on the outward strokes of the free pistons.

The free piston gasifier thus described is conventional and operates in the usual fashion, combustion in the diesel cylinders powering the outward strokes of the pistons, compressing the air in the bounce chambers and drawing air into the compressor chambers. The compressed air in the bounce chambers powers the inward strokes of the pistons and delivers air under compression from the compressor chambers to the air boxes. The diesel cylinders are fed with compressed air from the air boxes and deliver combustion products under pressure to the turbine when the pistons are in outboard position. During gasifier operation, the pistons in the lower engine 10 have their outward strokes while the pistons in the upper engine 10' have their inward strokes. This dephasing of the upper and lower pistons results in a less fluctuating flow of exhaust gas to the turbine than would be the case were the pistons in phase and also allows the upper and lower compressors to be fed alternately by a common air intake unit to thus increase the effective inlet area into the room.

The illustrated gasifier is designed for normal operation of about 600 cycles per minute for each engine and compressor pistons have a 35 inch diameter. It is readily apparent then that the compressor valves and any room housing the engine will be subjected to periodic massive air inhalations. To overcome the resulting sound disturbances noted earlier, each end of the gasifier is provided with an air intake assembly 30 consisting of housings 32 for the lower engine and similar housings 32' for the upper engine, the respective upper and lower housings being in communication with each other.

The housings 32 and 32' have peripheral walls 34 and 34' secured to the ends of the air boxes 12 and 12' and extending around the cylinders 16 and 16' in spaced relation. End walls 36 and 36' connect the peripheral walls 34 and 34' to the ends of the cylinders 16 and 16' leaving the bounce covers 22 and 22' exposed so the pistons may be removed for maintenance without disturbing the air inlet assemblies 30. The housings 32 and 32' also have intermediate sloping partition walls 38 and 38' which extends between the cylinders 16 and 16' and the peripheral walls 34 and 34' to form annular chambers 40 and 40' and 42 and 42' about the cylinders 16 and 16'. The peripheral walls 34 and 34' connect together between the cylinders at 44, the intermediate partition walls 38 and 38' connect together at 46 and the end walls 36 and 36' connect together at 48, thus placing the chambers 40 and 40' in communication with each other and the chambers 42 and 42' in communication with each other.

A plurality of venturi tubes 50 and 50' are mounted in the partition walls 38 and 38' to place the annular chambers 40 and 40' in communication with the annular chambers 42 and 42'. The chambers 40 and 40' contain the intake valves 28 and 28'. A plurality of plates 52 and 52' having a multitude of small apertures 54 and 54' are mounted in the peripheral walls 34 and 34' to provide an air inlet to the chambers 42 and 42'. The perforated plates 52 and 52' comprise portions of otherwise conventional air filter assemblies 56 and 56'.

The gasifier is thus supplied with air from the engine room by way of the intake valves 28 and 28', the compartments 40 and 40', the venturis 50 and 50', the compartments 42 and 42', the multitude of small apertures 54 and 54' and the filters 56 and 56'. As noted previously, the engines 10 and 10' are Siamesed and operate with their pistons dephased. The interconnected air inlet housings 32 and 32' are thus utilized to the fullest extent since only one compressor piston is on a suction stroke at any given time. The total throat area of the venturis 50 and 50' is related to the normal intake air flow of the gasifier to result in substantially sonic air flow at the throats. The high frequency, high energy sound generated by the valves 28 and 28' is thus unable to escape the chambers 40 and 40'. The chambers 42 and 42' draw the intake air from the engine room through the multitudinous apertures 52 and 52' which spread the intake over enough of the room area that low frequency vibrations are not set up by the periodic massive air inhalations. The air flow through the apertures may generate some high frequency sound but such sound is at such a low energy level as to be readily tolerated. The filters 56 have some sound deadening effect but are primarily provided to function as air cleaners.

While the embodiment of the invention here described is preferred other embodiments may be made within the scope of the invention.

We claim:

1. In a free piston engine having a compressor cylinder with an annular row of air intake valves generating excessive sound during engine operation through periodic massive air inhalations, air intake means for the valves for reducing the sound to a tolerable level comprising a housing assembly enclosing the valve portion of the cylinder and having walls forming first and second chambers and a plurality of venturis in the housing placing the chambers in communication with each other, the first chamber being in communication with the valves and the second chamber having a multitude of small apertures in a wall thereof communicating with atmosphere.

2. In a free piston engine having a compressor cylinder with an annular row of air intake valves generating excessive sound during engine operation through periodic massive air inhalations, air intake means for the valves for reducing the sound to a tolerable level comprising a unitary housing enclosing the valve portion of the cylinder and having walls forming first and second chambers each providing an annular space about the cylinder and an annular row of venturis in the housing placing the chambers in communication with each other, the first chamber being in communication with the valves and the second chamber having a multitude of small apertures in a wall thereof communicating with atmosphere.

3. In a free piston engine having a compressor cylinder with an annular row of air intake valves generating excessive sound during engine operation through periodic massive air inhalations, air intake means for the valves for reducing the sound to a tolerable level comprising a unitary housing enclosing the valve portion of the cylinder and having walls forming first and second chambers each providing an annular space about the cylinder, the ends of the cylinder being free of the housing, an annular row of venturis in the housing placing the chambers in communication with each other, the venturis extending in parallel relation with the axis of the cylinder, the first chamber being in communication with the valves, and a plurality of perforated plates and filter elements arranged about the cylinder in a wall of the second chamber placing the chamber in communication with atmosphere.

4. In a Siamesed free piston engine having adjacent compressor cylinders each with air intake valves generating excessive sound during engine operation through periodic massive air inhalations, the inhalations of one cylinder being out of phase with the inhalations of the other cylinder, common air intake means for the valves for reducing the sound to a tolerable level comprising a housing enclosing the valve portions of both cylinders and having walls forming first and second chambers and including a plurality of venturis placing the chambers in communication with each other, the first chamber being in communication with the valves of both cylinders and the second chamber having a multitude of small apertures in a wall thereof communicating with atmosphere.

5. In a Siamesed free piston engine having adjacent compressor cylinders each with an annular row of air intake valves generating excessive sound during engine operation through periodic massive air inhalations, the inhalations of one cylinder being out of phase with the inhalations of the other cylinder, common air intake means for the valves for reducing the sound to a tolerable level comprising a unitary housing enclosing the valve portions of both cylinders and having walls forming first and second chambers each providing an annular space about both cylinders and an annular row of venturis in the housing placing the chambers in communication with each other, the first chamber being in communication with the valves of both cylinders and the second chamber having a multitude of small apertures in a wall thereof communicating with atmosphere.

6. In a Siamesed free piston engine having adjacent compressor cylinders each with an annular row of air intake valves generating excessive sound during engine operation through periodic massive air inhalations, the inhalations of one cylinder being out of phase with the inhalations of the other cylinder, common air intake means for the valves for reducing the sound to a tolerable level comprising a unitary housing enclosing the valve portions of both cylinders and having walls forming first and second chambers each providing an annular space about both cylinders, the ends of the cylinders being free of the housing, an annular row of venturis in the housing extending in parallel relation with the axis of the cylinder and placing the chambers in communication with each other, the first chamber being in communication with the valves of both cylinders, and a plurality of apertured plates and filter elements arranged about the cylinder in a wall of the second chamber placing the chamber in communication with atmosphere.

References Cited in the file of this patent

UNITED STATES PATENTS

2,711,719	Huber	June 28, 1955
2,798,470	Kiekhaefer	July 9, 1957

FOREIGN PATENTS

201,819	Australia	Aug. 25, 1955